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EARLY INDIVIDUALITY: BEHAVIORAL DIMENSIONS IN ONE-YEAR-OLDS AND DIMENSIONAL STABILITY IN INFANCY

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ABSTRACT

The purpose of the study was to establish dimensions of functioning accounting for interindividual variation in behavior in the later infancy period and to investigate the stability of the dimensional structure during the infancy period. Factor analyses were performed on parent questionnaire data for 357 infants, aged 11 to 15 months. An 8-factor solution was accepted as the best one and cross-validation analyses showed it to be stable.A comparison with a 7-factor solution previously obtained in a group of 3 to 10 months old infants revealed high similarity in dimensional structure between the two age groups. Apart from an additional eighth factor appearing in the older sample the same seven dimensions were obtained. These were named Intensity/Activity, Regularity, Approach-Withdrawal, Sensory Sensitivity, Attentiveness, Manageability, and Sensitivity to New Food. The conceptual status of these factors was discussed.

A growing interest for individual differences during childhood has prompted a search for fundamental dimensions of functioning that could account for interindividual variation in specific behaviors. The nine behavioral dimensions proposed by the New York Longitidunal Study (NYLS)(Thomas et al.1963) are probably the most wellknown. These dimensions were originally established by inductive content analysis performed on interview data from 22 children, aged two to three months (Thomas at al. 1963; Chess & Thomas 1973). Following the NYLS studies several attempts have been made to delineate dimensions in child behavior by factor analytic procedures applied to parental interview or questionnaire data (e.g. Garside et al. 1975; Rowe & Plomin 1977; Bohlin et al. 1979). In most of this research it is implicitly or explicitly assumed that there is some degree of stability of behavioral individuality over time. This notion seems to imply the further assumption that although the behavioral repertoire itself changes with age it can still be represented by the same fundamental dimensions.

The empirical evidence concerning the stability of the dimensional structure over different age periods is rather meagre. In the NYLS this problem was handled by trying to use the dimensions originally defined for children two to three months of age also for categorization of the behavior of older children. Since this was found possible it was concluded that the same nine dimensions are fundamental throughout childhood. This reasoning, however, is likely to yield a bias against detecting changes in the dimensional structure. Factor analytic studies allow a stricter approach to the problem of dimensional stability; by comparing factor structures

obtained for various age groups, similarities and discrepancies can be specified.

McDevitt (1976) and Rowe and Plomin (1977) compared factor structures, but in neither case were detailed results presented. Rowe and Plomin (1977) contended that the same six factors appeared in a group of children aged four months to four years and a group aged four to nine years. McDevitt (1976) reported factor stability for two dimensions between infancy (4 - 8 months) and childhood (3 - 5 years). In our own study (Bohlin et al. 1979) the same seven dimensions were found to be represented in the behavioral repertoire of infants aged 3 to 6 and 6 to 10 months.

A comparison of the above studies elucidates some methodological issues pertinent to the study of dimensional structure in child behavior. As compared to Bohlin et al. (1979) the other two investigations used groups whose mean ages were further apart and for which the age range within each group was wider. These differences are related to a more general methodological issue of relevance when child behavior is studied by parental questionnaire or interviews, namely the specificity of item content. In order to reduce the influence of stereotyped parental opinions, both in establishing the original dimensions and in evaluating dimensional stability, it would be preferable to use items which are specific in terms of behavior and situation (cf. Thomas et al. 1963). The items used by Rowe and Plomin (1977) were of a rather generalized nature compared to those used by Bohlin et al. (1979). i.e. "Child tends to be shy" versus "When meeting a stranger, the child's first reaction is positive (laughs, smiles)/negative (cries, whimpers)."

When more specific items are used, the set of items has to be repeatedly modified to make it applicable to the developing behavioral repertoire. Thus, the time intervals during which certain sets of items are considered applicable set limits as to the age range of each age group. Each renewal of the set of items also requires that the dimensional structure is re-established.

Apart from these purely methodological reasons for using groups not too widely separated in age, such a strategy is also advantageous in providing a more complete picture of developmental changes in the dimensionality of child behavior.

The main intention of the present study was to investigate the dimensional structure of children in the later infancy period. To achieve this, a previously used questionnaire (Bohlin et al. 1979) was adapted to the behavior of children around one year of age and factor analysis was applied to data collected with the new questionnaire. Finally, in order to investigate the stability of dimensions in early childhood, the obtained structure was compared to the one previously established for younger age groups in our research.

METHOD

Questionnaire

The infant questionnaire used in our previous study (Bohlin et al 1979) was developed from the Infant Temperament Questionnaire (Carey 1970) which in its turn was based on the NYLS dimensions. The questionnaire to be answered by parents consisted of 54 items covering the behavioral repertoire of infants aged 3 to 10 months. The response scale had 5 distinct categories with verbal definitions of the end alternatives. Guided by interviews with parents of one-year-olds, this questionnaire was adapted to cover the behavioral repertoire of children around the age of one year. With slight reformulations of

some statements, 51 of the original 54 items could be retained. Nine new items were constructed to give a total of 60 items, describing specific reactions in well-defined situations. The aim was to cover most of the situations that Swedish one-year-olds encounter.

Sample

The questionnaire was mailed to the parents of all children born in Uppsala county during certain months. Three reminders were sent at two-week intervals.

Of 513 mailed questionnaires 357 were returned, which gave a response frequency of 69.6%. The age of the children at the date the inventory was answered ranged between 48 and 64 weeks, i.e. 11 and 15 months ($\bar{X}$ = 12.67, s = .76).

Factor analyses

Each item was given a score from 1 to 5. The product moment correlation was used as a covariate measure and factor analyses were performed with a subprogram within the Statistical Package for the Social Sciences (Nie et al. 1975). For exploratory analyses factors were extracted by means of the principal factoring method, using an iteration process to estimate communalities. The extracted factors were orthogonally rotated according to the varimax criterion and obliquely rotated according to the direct quartimin criterion. For confirmatory analyses orthogonal procrustean transformations were used. By this method a factor matrix is rotated to approximately fit a target matrix (Gorsuch 1974). In interpreting the factors only items with loadings ≥.30 were considered.

RESULTS

Preferred solution

The scree test (Gorsuch 1974) applied to the present questionnaire data indicated that seven or eight factors could be considered non-trivial. Thus, exploratory analyses with orthogonally and obliquely rotated 7- and 8-factor solutions were compared. In terms of hyperplane counts (Gorsuch 1974) and items loading in more than one factor, the comparisons favored the orthogonal method of rotation. The factor structure was stable across different solutions, the only exceptions being the first two factors in the oblique 7-factor solution which showed a different clustering of items than the other solutions. The intercorrelations between factors in the oblique solutions were generally low, about 50% being <.10 and the highest being .22. In terms of interpretability and meaningfulness, the two 8-factor solutions were about equally good and better than the 7-factor solutions. On the basis of these facts and judgments, the orthogonal 8-factor solution was chosen as the best solution, both in terms of structure simplicity and interpretability. This solution which accounted for 34.3% of the total variance had 62% of the loadings in the hyperplane and two items that loaded in more than one factor.

Cross-validation

The sample was randomly split in two subsamples with N=178 and N=179, respectively. Exploratory orthogonal 8-factor solutions were sought independently for each subsample. As can be seen in Table 1, fairly good replications of the solution for the total sample were obtained in both subsamples, even if factor 8 did not appear in subsample 1.

Insert Table 1 about here

As a second step in the cross-validation analyses, the solutions for the subsamples were Procrustes rotated to maximally fit the 8-factor solution for the total sample. Factor loadings resulting from these confirmatory analyses as well as coefficients of congruence between corresponding factors in the target and Procrustes rotated matrices are presented in Table 1. The size of the coefficients indicates high factor similarity in the different samples; only a couple of the coefficients do not quite reach .80. As a check against unacceptably high capitalization on chance in the procrustean transformations, coefficients of congruence between all factors were calculated and found to be generally low, only three exceeding .30. The distribution of differences between factor loadings in the solution for the total sample and factor loadings in the Procrustes rotated solution for the first subsample yielded a mean of -.004 and a standard deviation of .078. Corresponding values for the second subsample were .005 and .086. It was concluded that the 8-factor solution had been replicated in the two subsamples and it could therefore be seen as representing dimensions of functioning in children aged 11 to 15 months. This solution with verbal description of each item, factor loadings, and communalities is presented in Table 2.

Insert Table 2 about here

Interpretation of factors

As can be seen in Table 2, the emphasis in the first factor was on the intensity and activity aspects of behavior. In factor 2, items reflecting mainly mood and persistence had clustered. This factor was interpreted as representing parents' appraisal of the manageability of the child. Factor 3 mirrored the regularity in some biologically based functions while the fourth factor comprised items measuring the child's reactions to strangers and to new situations. Factor 5 could be seen as reflecting sensory sensitivity to strong stimuli and factor 6 consisted chiefly of items describing reactions to new food, i.e. behavior in a fairly specific situation. The seventh factor concerned mainly the child's reactivity or attentiveness to minor changes and differences in the environment. The three items in the eighth factor, which had been shown to be somewhat less stable than the other factors, could possibly be seen as reflecting the adaptability of the child. The eight factors were thus named Intensity/Activity, Manageability, Regularity, Approach-Withdrawal, Sensory Sensitivity, Sensitivity to New Food, Attentiveness and Adaptability.

Comparison between factor structures for children aged 3 - 10 months and 11 - 15 months

The same procedures as those described above had previously been applied to questionnaire data for infants aged 3 to 10 months (Bohlin et al. 1979). A comparison between the factor structures in the two age groups is presented in Table 3, revealing a high degree of resemblance

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Insert Table 3 about here

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between the 7-factor structure obtained in the younger age group and the first seven factors extracted in the older group. If items that were new or reformulated in the 11 to 15 months questionnaire are excluded, an examination of the specific items loading in different factors will reveal five identical or almost identical factors in the two age groups. The factors named Attentiveness and Manageability in both samples display somewhat greater disparity but variables that are markers in one age group are to a large extent included in the corresponding factor in the other age group. Hence, seven factors could be interpreted in the same terms in both age groups.

DISCUSSION

The presently reported data stem from a larger research project in which a main goal has been the delineation of dimensions of early individuality. Systematic investigations of two consecutive age periods during the first year of life have disclosed essentially the same dimensional structure in both groups. Data from a third age period during infancy have now been shown to elicit a factor structure highly similar to the one derived from the combined younger samples. It is worth pointing out that, while the same questionnaire was used with the first two samples, the behavioral and situational content of the questionnaire for the third age group was altered to better fit the everyday life of one-year-olds. Still, the dimensional structure remained essentially unchanged. Thus, seven factors accounting for about a third of the total variation in behavior seem to be applicable during the whole infancy period. An eighth factor may be seen as an emerging dimension during the latter part of the period.

A majority of the factors are easily interpreted in terms of broad

dimensions of behavioral functioning in infancy. Two of the factors however, are not immediately identified as general behavioral dimensions. A factor interpreted as reflecting reactions in the feeding situation, particularly to new food, was obtained in all age groups. Because of the specific nature of this factor, its value as a general dimension of functioning can be questioned (cf. Bohlin et al. 1979). A similar, specialized factor was extracted in the Rowe and Plomin (1977) study; they, however, did include this reaction-to-food-factor among their six dimensions of personality.

Unlike the rest of the factors in the present study, the factor named Manageability was difficult to conceive of in terms of a single dimension of infant behavior. Rather it might reflect parental attitudes or aspects of the parent-infant relationship. On the other hand, the possibility that this factor may be a somewhat indirect representation of an infant behavioral dimension of irritability cannot be excluded. This question must await further research for its final solution. Irrespective of its interpretation the dimension of Manageability seem to become more important with age. In the exploratory analyses it did not appear in the youngest age group studied but was identified as number three of the eight factors extracted in the sample of 6- to 10-month-olds. In the solution for the combined younger age groups it appeared as numler six in the preferred 7-factor solution. The Manageability factor in these solutions accounts for 14.7% and 7.3%, respectively, of the total amount of variance extracted. In the various exploratory analyses performed on the present data concerning infants aged 11 to 15 months, the dimension of Manageability occupies a more central position. Oblique solutions invariably extract this dimension as the first factor, account

ting for about 24% of the variance, whereas in the orthogonal solutions it is the second factor extracted, explaining about 22% of the variance.

The preferred solution for the combined younger age groups contained seven factors while in the present study an 8-factor solution was judged the best one. An inspection of the three items forming the additional factor shows that two of them belonged to the more general Manageability factor in the younger age group. One of these two items is found also in the Manageability factor in the sample of 11- to 15-month-olds. On the basis of presently available data - this factor being somewhat less stable than the other factors and containing few items with relatively low loadings - the eighth factor might be considered trivial. However, the possibility still exists that it could be a weak representation of an emerging dimension of Adaptability. Such a dimension has previously been described by Thomas et al. (1963) while Garside et al. (1975) mention poor adaptability as part of a more general withdrawal and dependence factor in their sample of five-year-olds.

In some of the inspected solutions for infants aged 3 to 10 months, a factor interpreted to measure frustration tolerance appeared. Since this factor was not identified in the final solution and since it did not occur in the presently reported analyses, a dimension of frustration tolerance does not seem to be a prevalent feature of infant functioning. Questions concerning the exhaustiveness of the established dimensional structure, and the relations between the present dimensions and those reported by other investigators of infant individuality, as well as problems of the validity of parent ratings, have been discussed elsewhere (Bohlin et al. 1979).

The significance of the present study lies in the demonstration of

stability in general behavioral tendencies over the infancy period. The same seven dimensions have been found to characterize behavior throughout the first year of life and in the beginning of the second year as well. Having established dimensional stability, a study of the stability of individual differences over time becomes possible.

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Table 1

Factor loadings ≥ .30 in the preferred solution and loadings for the same items in the cross-validation analyses.

			Independent rotation		Procrustes rotati	
			Subsample		Subsample	
	Item No	Tot. ample	1	2	1	2
Factor 1	28	.51	-	.54	.59	.55
	52	.45	.41	.38	.41	.40
	27	.45	-	.54	.45	.53
	24	.40	.41	.45	.35	.44
	54	.40	-	.47	.29[x]	.45
	42	.39	.37	.42	.32	.43
	44	.38	.43	.40	.33	.44
	19	.36	.36	.39	.33	.39
	55	.31	-	.27[x]	.35	.31
Coeff. of congruence[xx]					.96	.96
Factor 2	23	.58	.57	.54	.60	.54
	30	.50	.52	.48	.52	.47
	17	.49	.52	.46	.52	.48
	53	.45	.44	.45	.40	.43
	22	-.40	-.35	-.38	-.40	-.38
	49	.39	.50	.30	.45	.32
	51	.39	.46	-	.41	.29[x]
	29	.34	.33	.38	.32	.36
	15	.32	.39	-	.35	.26[x]
Coeff. of congruence[xx]					.96	.94
Factor 3	2	.84	.78	.79	.81	.63
	1	.74	.80	.64	.78	.79
	9	.46	.44	.56	.44	.54
	11	.37	.45	.36	.43	.37
Coeff. of congruence[xx]					.95	.95

Table 1 - Continued

			Independent rotation		Procrustes rotation	
			Subsample		Subsample	
	Item No	Tot. sample	1	2	1	2
Factor 4	47	.70	.75	.60	.75	.63
	48	.69	.71	.68	.71	.68
	43	.62	.55	.65	.55	.67
	34	.33	.46	-	.36	.27[x]
	35	.31	.38	-	.38	-
Coeff. of congruence[xx]					.94	.93
Factor 5	38	.73	.80	.63	.80	.52
	37	.70	.68	.52	.68	.42
	39	.61	.68	.57	.67	.45
Coeff. of congruence[xx]					.94	.72
Factor 6	18	.69	.58	.65	.61	.61
	20	.54	.56	.50	.54	.54
	13	-.44	-.30	-.62	-.39	-.53
	12	.43	.54	.32	.55	.37
	19	-.32	-	-.48	-	-.45
Coeff. of congruence[xx]					.89	.93
Factor 7	45	.43	.46	.41	.45	.37
	40	.40	.57	.33	.59	-
	10	.35	-	.29[x]	.27[x]	.53
	46	.35	.33	.45	.34	.33
	5	.32	-	.41	-	.31
	19	.30	.33	.29[x]	.30	.34
Coeff. of congruence[xx]					.81	.80
Factor 8	6	.46	-	.38	.32	.41
	33	.30	-	.44	-	.45
	51	-.30	-	-.39	-	-.36
Coeff. of congruence[xx]					.76	.84

[x] Loadings $\geq .25$ and $< .30$

[xx] Based on all 60 items

Table 2

Items with loadings ≥ .30 in the preferred solution

Factor Name	Item No	Description	Scale End-points	Loading	Communality
1. Intensity/ Activity	28	Intensity of reactions during bath	high-low	.51	.26
	52	Mood during play	pos.-neg.	.45	.27
	27	Activity during bath	high-low	.45	.24
	24	Intensity of reactions during diaper changing	"	.40	.22
	54	Activity during play	"	.40	.23
	42	Intensity of reactions to familiar persons	"	.39	.22
	44	" " " " strangers	"	.38	.23
	19	" " " " new food	"	.36	.3[illegible]
	55	Persistence when playing with another person	"	.31	.22
2. Manage-ability	23	Mood during diaper changing	pos.-neg.	.58	.36
	30	" when being dressed in out-door-clothing	"	.50	.30
	17	" " having face wiped	"	.49	.26
	53	Persistence when watching TV/reading book	high-low	.45	.28
	22	Activity during diaper changing	"	-.40	.28
	49	Persistence in self-amusement	"	.39	.27
	51	" when playing with new toy	"	.39	.33
	29	Mood during nail cutting	pos.-neg.	.34	.13
	15	Concentration when eating	high-low	.32	.16
3. Regularity	2	Regularity in times of waking up	reg.-irreg.	.84	.72
	1	" " " " falling asleep	"	.74	.57
	9	" " " " being awake and alert	"	.46	.25
	11	" " " " wanting to be fed	"	.37	.38
4. Approach-Withdrawal	47	Mood when carried by a stranger	pos.-neg.	.70	.58
	48	Acceptance of being left alone with stranger	yes-no	.69	.52
	43	Mood when first meeting a stranger	pos.-neg.	.62	.39
	34	Adaptability in new situations/ places	high-low	.33	.24

Table 2 - Continued

Factor Name	Item No	Description	Scale End-points	Loading	Communality
4. Approach-withdrawal	35	Mood when examined in child health center	pos.-neg.	.31	.15
5. Sensory Sensitivity	38	Intensity of reactions to sharp light	high-low	.73	.65
	37	" " " " strong sounds	"	.70	.55
	39	" " " " rapid movements	"	.61	.46
6. Sensitivity to New Food	18	Acceptance of new food	rapid-slow	.69	.49
	20	Adaptability to " "	"	.54	.35
	13	Sensitivity to differenses in taste	high-low	-.44	.29
	12	Regularity in amount of food intake	reg.-irreg.	.43	.29
	19	Intensity of reactions to new food	high-low	-.32	.3
7. Attentiveness	45	Differential reactions to adults and children	yes-no	.43	.21
	40	" " to different voices	"	.40	.19
	10	Hunger reactions overtly demonstrated	"	.35	.19
	46	Reactivity to physical differences in people	high-low	.35	.16
	5	" " change in sleeping times	"	.32	.29
	19	Intensity of reactions to new food	"	.30	.3
8. Adaptability	6	Adaptability of sleeping habits to environmental change	rapid-slow	.46	.29
	33	" " "safety chair" in car/"rucksack carrier"	"	.30	.13
	51	Persistence when playing with new toy	high-low	-.30	.33

Table 3

Items with loadings ≥ .30 in the preferred solutions for two-age groups of infants.

Factor Name	Description	Loadings 3-10 mo.	11-15
Intensity/ Activity	Intensity of reactions to familiar persons	.49	.39
	" " " during bath	.49	.51
	" " " " diaper changing	.48	.40
	" " " to strangers	.41	.38
	Mood during play	.39	.45
	Activity during play	.39	.40
	Intensity of reactions to new food	.36	.36
	Activity during bath	.34	.45
	Intensity of reactions to frustration	.32	+
	Activity during diaper changing	.31	-
	Persistence when playing with another person	++	.31
Manage-ability	Mood during diaper changing	.46	.58
	Persistence in self-amusement	.42	.39
	Adaptability of sleeping habits in new places	.37	-
	Mood before falling to sleep	.37	.29[x]
	Activity during diaper changing	-.33	-.40
	Mood when being dressed in out-door clothing	.33	.50
	Sensitivity to sounds when asleep	.32	-
	Presistence when playing with toy	.32	.39
	Adaptability in new situations/places	.30	-
	Activity during bath	-.30	-
	Mood when having face wiped	+	.49
	Persistence when watching TV/reading book	++	.45
	Mood during nail cutting	-	.34
	Concentration when eating	++	.32
Regularity	Regularity in times of falling asleep	.80	.74
	" " " " waking up	.79	.84
	" " " " wanting to be fed	.53	.37
	" " " " being awake and alert	.44	.46
	" " " " bowel movements	.36	+
	" " amount of food intake	.32	.26[x]

Table 3 - Continued

Factor Name	Description	Loadings 3-10 mo.	11-15
Approach-Withdrawal	Mood when carried by a stranger	.68	.70
	" " first meeting a stranger	.61	.62
	" " examined in child health center	.40	.31
	Adaptability in new situations/places	.39	.33
	Acceptance of being left alone with stranger	++	.69
Sensory Sensitivity	Intensity of reactions to rapid movements	.64	.63
	" " " " strong sounds	.63	.70
	" " " " sharp light	.61	.73
Attentiveness	Differential reactions to adults and children	.58	.43
	Mobility when placed on floor/bed	.46	++
	Differential reactions to different voices	.45	.40
	Reactivity to physical differences in people	.42	.35
	" " feeding preparations	.40	++
	Acceptance of new toy	.38	+
	Hunger reactions overtly demonstrated	++	.35
	Reactivity to change in sleeping times	-	.32
	Intensity of reactions to new food	-	.30
Sensitivity to New Food	Acceptance of new food	.68	.69
	Adaptability to new food	.57	.54
	Sensitivity to differences in taste	-.39	-.44
	Regularity in amount of food intake	+	.43
	Intensity of reactions to new food	-.28[x]	-.32

[x] Loadings $\geq .25$ and $< .30$

\+ Item reformulated in questionnaire for 11-15 mo. olds

++ Item not included in questionnaire for this age group